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Integration of Cell Phone Technology with Marine Corps Tactical Communication Networks

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NAVAL POSTGRADUATE SCHOOL

Problem:

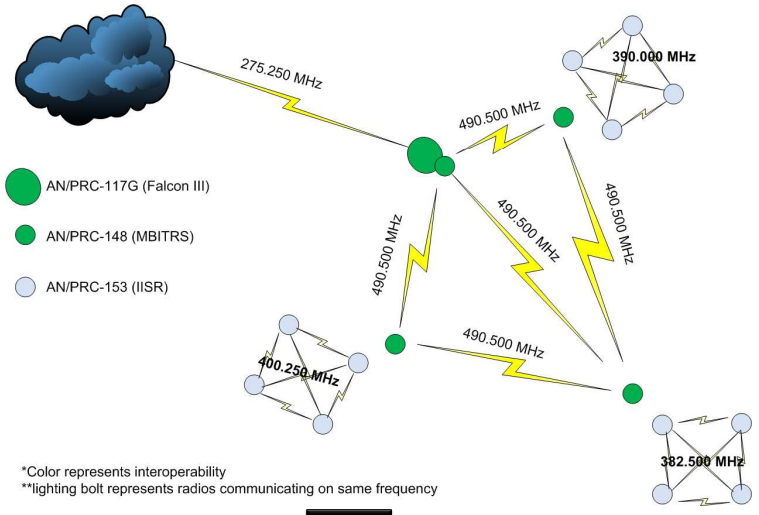
The research idea is motivated from the current lack of communication capabilities observed by Marines while in a tactical / field environment. Imagine highly mobile units either providing disaster relief, humanitarian assistance, or conducting full-scale combat operations. These environments all share a common demand for a highly mobile ad-hoc wireless network. Normally, cell phone towers and/or pre-laid fiber cables could provide a solid communication backbone for the network. However, these assets are usually unavailable or unsecure in these types of environments. Therefore, the military relies on specific radios:

Current Military Communication equipment at the company level (140 Marines)

Harris AN/PRC-117G Wideband Multiband Multi-mission Radio (Falcon III)
(one per company)

- Spectrum: 30 MHz – 2 Ghz VHF/UHF
- Operational Mode: Voice/Data
- Encryption: Type 1 (Suite A)
- Data Rate: 10 Mbps

» JTRS APPROVED
» JTEL CERTIFIED
» NSA CERTIFIED
» JITC CERTIFIED



*Color represents interoperability
**lighting bolt represents radios communicating on same frequency

FIGURE 1

*All statistics came directly from manufactures website

Thales AN/PRC-148 Multiband Inter / Intra Team Radio (MBITR)
(24 per company)

- Spectrum: 30 MHz – 512 Mhz VHF/UHF
- Operational Mode: Voice/Data
- Encryption: Type I (Suite A), III DES
- Data Rate: 16 kbps

Motorola AN/PRC-153 Integrated Intra-Squad Radio (IISR)
60 per company

- Spectrum: 380 MHz – 470 MHz UHF
- Operational Mode: Voice Only
- Encryption: AES 256 bit

The I/O on these devices are limited to text based displays and numeric keypad. This is sufficient for initial setup and ongoing adjustments. The IISR radios by design are half-duplex voice communication devices. Furthermore, the IISRs communicate on different protocols preventing a unified network. As a result, a Marine carrying an IISR can only communicate via a single voice channel to other members with the same radio and frequency settings within a 1-km range. Without interoperability between the radios the communication topology ends up like Figure 1 depicted to the left, where IISR communications are limited to single hop and require human in the loop in order to leverage the MBITRs for intergroup message relays. Therefore, communications are primarily exchanged through voice and require the human in the loop to traverse the various the local networks.

Approach:

Our primary goal is to increase communication capabilities, while minimizing the amount, physical size, and cost of the specialized hardware. From this perspective, cell phones possess the most desirable characteristics: low cost, small form factor, millions of daily users, hundreds of competing companies to develop the latest and greatest technology, and an abundant of other highly valuable features. However, COTS cell phones out of the box fall short of military requirements, because of their limited encryption capabilities, jamming vulnerabilities, and network topology.

Possible topologies:

Option 1: Connect a cell phone through a standard wireless protocol to a modular device, which is connected via Ethernet cable to a tactical radio.

Option 2: Customize a cell phone to communicate directly with tactical radios.

Option 3: Upgrade tactical radios to communicate on both frequency bands simultaneously (two separate RF chipsets and antennas) .

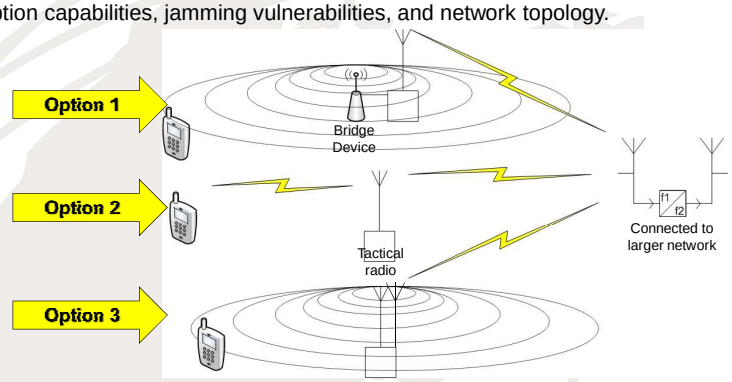


FIGURE 2

Progress:

Initially, we established the validity of option 1 in two ways. First, we connected and configured a network of computers utilizing the a tactical radio link. The results of this experiment validated the possibility of creating a computer network across tactical radios. The next obstacle was to replace the desktop computers with cell phones. Next, we successfully communicated across two proprietary cell phones via a modular small sized bridge device, which was networked to a desktop computer (simulating a tactical radio). The computer effectively monitored traffic and connections between each cell phone on the network. During this experiment voice and data traffic were exchanged. The next step is to combine those two experiments by eliminating the computers and implementing option 1.

Future:

Over the next 18 months the research will explore each of the above options in order to develop viable solutions. The three elements in particular are cell phones, bridges, and tactical radios. The development of the cell phone technology is software oriented. The bridge device research is limited to building a software defined radio prototype and experimenting with various commercial solutions. The tactical radio research is focused on upgrading the current systems in order to amalgamate the technologies in addition to exploring resulting capabilities and limitations. What will the maximum number of simultaneous cell phone connections be? What topology will minimize the latency while maximizing the security? What encryption algorithm is sufficient for the required connecting network and open enough for implementation on standard cell phones?

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